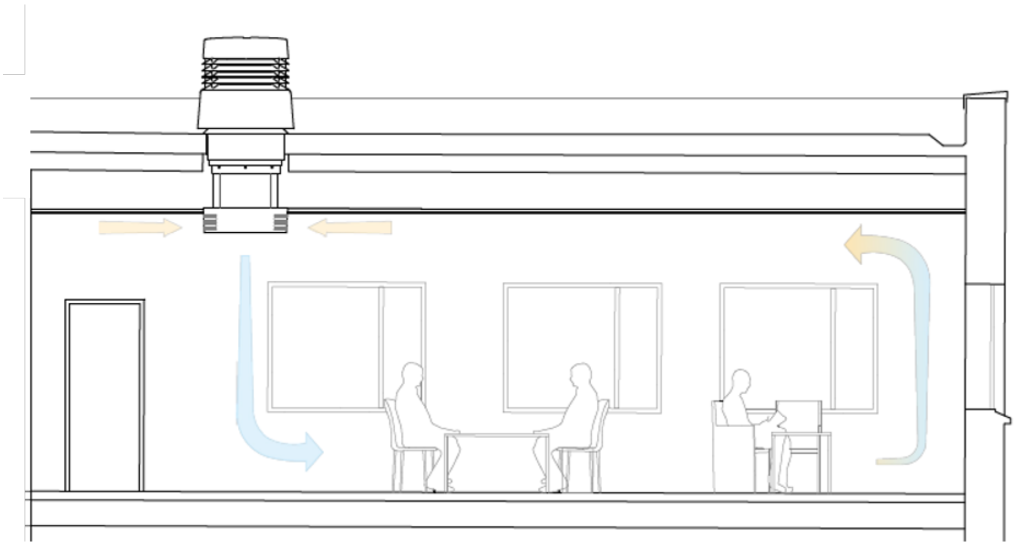
What is passive ventilation with heat recovery?

Passive Ventilation with Heat Recovery (PVHR™) is a patented method of delivering high thermal efficiency and consistent air flow using natural ventilation systems by securely transferring the heat from exhaust air to fresh incoming air. It was developed in 2013 with help from researchers at Imperial College London to retrofit houses with ventilation systems that remove stale air, damp and pollutants. It has since been expanded for use in schools, offices and new-build housing projects.

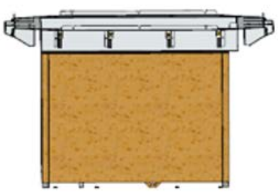
The technology combines the simplicity of passive-stack with the heat recovery performance of a powered mechanical device - without the cost, maintenance and energy use associated with them. It depends on the natural air current of rising hot air generated within the building to expel stale air, damp and pollutants while drawing in fresh air from outside. Recovering heat from outgoing 'stale' air and transferring it to incoming fresh air, it works by using wind and natural buoyancy for a passive airflow, it has no moving parts to break down and requires no energy to run.



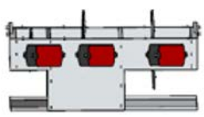
What's in a PVHR system?

Cowl

Heat exchanger



Diffuser



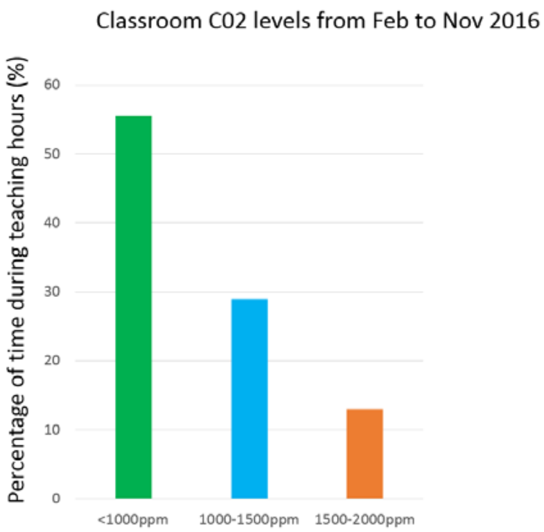
The system consists of three elements to deliver its design features; a roof-mounted cowl, a heat exchanger and an air flow diffuser. The cowl sits on the roof of a building and is designed to catch the wind, pushing it into the system. The combination of wind and buoyancy provides ample force for the supply air flow.

The second element is a heat recovery assembly of two coaxial heat exchangers. Incoming and outgoing air flows are directed through a series of intertwining metallic tubes. Aluminium fins in each tube transfer the heat from the higher temperature air flow to the lower, without any mixing of air supplies. This is to say that when the temperature of the exhaust classroom air is higher than incoming fresh air, the incoming fresh air will be heated up. In summer where external temperatures can be higher, the incoming air is cooled down.

The third element is an air flow diffuser that sits in the ceiling of a room that supplies fresh, tempered air into the room. Openings in the side gather warm stale air that rises due to its buoyancy, and transfers it upwards, through the heat exchanger and outside. In this way there is a constant circulation of fresh air for occupants, no cold draughts, heat recovery at zero energy cost, and a secure way of ventilating rooms overnight.

How effective is PVHR?

A ventilation system must provide air quality with minimal impact on electricity usage and classroom temperatures. Real-life performance data from Horniman primary school in Lewisham that was presented at the CIBSE Technical Symposium in 2017 has shown a Ventive PVHR unit achieving heat recovery with an efficiency of 94% across a nine month period. CO_2 levels in the monitored classroom remained below 1000ppm for 55.5% of occupied hours, below 1500ppm for 85% of occupied hours and below 2000ppm for 97.5% of occupied hours, well within the requirements for school classrooms.



Longer term testing has shown 72% thermal efficiency is regularly achieved, at a saving of 1,500kWh per year. The system works best when there is a significant difference between external and internal temperatures. This is because more heat is transferred when passing through the heat exchanger, and the buoyancy effect of warm air rising contributes to a faster rate of air flow into the room. Additionally, wind speed contributes to a greater supply of air into rooms.

An optional heat pump can be specified for Ventive windhive systems to efficiently accelerate ventilation rates by increasing the buoyancy effect.

Summer cooling

During warmer months, rooms can suffer from a build-up of heat over a period of time due to high external temperatures and solar gain. All indicators show our climate is getting warmer, so this is an issue that will become increasingly prevalent over the next 20 years and beyond. The only way to properly deal with overheating is by engaging in both day and night cooling.

In the daytime, occupancy heat gains are exacerbated by high external temperatures. Without the right ventilation strategy, rooms can quickly feel like a stuffy oven. Fan-based systems are able to provide consistent temperate climates, however there is an energy trade off. Modern heat exchangers are now able to extract the heat from incoming air and cool it down before supplying it to rooms. A high rate of flow makes for a pleasant breeze, giving an additional cooling effect.

Night cooling mitigates the compound build-up of temperatures, particularly for heat islands, and removes the possibility of rooms becoming unbearable. The only problem is that in the past, overnight ventilation has been expensive (running a fan overnight) or risky (leaving windows open). An elegant solution is to engage in purge ventilation using a wall-mounted louvre and ceiling-mounted vent. Pumping cooled air into a room via the louvre gives buoyancy to the warmer air, allowing it to exit through the ceiling and rapidly cool the room in a secure manner.

Early tests with the Ventive Windhive have shown performance at up to 4 air changes per hour (ACH), reducing temperatures by up to 10°C each night. This ensures that rooms are pre-cooled in the morning, providing an optimal environment.